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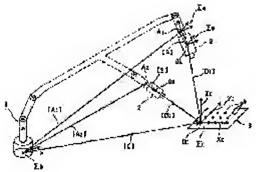
(54) COORDINATE SYSTEM SETTING METHOD USING VISUAL SENSOR



(57)Abstract:
PURPOSE: To set a coordinate system for operation which does not require skillfulness with stable precision by observing a coordinate system representing means, which visually represents the coordinate system, through the visual sensor which has a camera means supported on a robot, etc.
CONSTITUTION: An operator operates a robot controller to move the robot 1 to a 1st proper position A1 where a jig 3 is easily put in the visual field of the camera 2, and data on a matrix [A1] representing A1 are transferred from the controller 1 and stored. Then an observation is made at the position A1 through the camera 2 to store the image of a dot group 4 in a frame memory, and data of [D1] are found from pixel values are the respective dots in the dot group 4 and jig data. Similarly, the robot 1 is moved to a 2nd proper position A2 and data on a matrix [A2] are transferred and stored. An observation is made at the position A2 through the camera 2 and an image of a dot group 4 is inputted to find data of [D2]. Those data are used to calculate a matrix [C], thereby completing the setting of the coordinate system.

CLAIMS

[Claim(s)]
[Claim 1]A coordinate-system-setting method characterized by comprising the following using a visual sensor.
(a) It is made to take several positions which make an automaton with which at least one standard coordinates are set up support a camera means of a visual sensor, and are different, A stage of observing a coordinate system expressive medium which expresses a coordinate system wishing setting out visually in each of a position of these plurality by said camera means, and gaining sensor data about said coordinate system wishing setting out.
(b) A stage of gaining data showing a position and a posture of said coordinate system wishing setting out to said at least one standard coordinates based on data showing said several mutually different positions of an automaton, and said gained sensor data.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]Concerning the method of setting a coordinate system as automata, such as a robot, in more detail, a visual sensor is used in this invention. Therefore, it is related with the method of setting a coordinate system as coordinate system expressive media, such as a jig for coordinate system setting, by non-contact at automata, such as a robot.

[0002]
[Description of the Prior Art]In the automaton of the mold provided with the movable part which performs route movement according to the operation program which contains the data (only henceforth "position data") showing a position and a posture like a robot and a machine tool, two or more coordinate systems are set up and the conformity coordinate system at the time of operation is chosen according to work contents.
[0003]If the standard coordinates (henceforth a base coordinate system) fixed on the base of an automaton are ending with setting out, setting out of other coordinate systems will be attained by defining the transformation-matrix data showing the position and posture over the base coordinate system set [this] up.
[0004]In setting up a new coordinate system with such a method conventionally, Carry out fixed installation of the jig which expressed the coordinate system by the point group etc. to the position wishing setting out, and two or more prescribed spots of this jig are tagged up one by one in the portion representing the position of automata, such as a robot, Asking for transformation-matrix data is performed from the data of the touch position on a jig, and the position data of the automaton at the time of touch-up.
[0005]The point of specifically expressing the starting point as the 1st point, for example (0, 0, 0), The point of expressing X shaft orientation as the 2nd point (x0, 0, 0); Point (0, y0, 0);y0 !=0 on x0 !=0 and the Y-axis which expresses the direction of an XY plane as the 3rd point is chosen, The pin which an automaton tends to touch is set to these three

points, manual operation (jogging) of the automaton is carried out, and these pins are touched directly [order]. And the data (transformation-matrix data) which expresses relative position and posture over the base coordinate system of the coordinate system expressed with the jig from the position data of the automaton at the time of each tatting and the data of a touch position is called for.

[0006]

[Problem(s) to be Solved by the Invention]However, very strict and delicate manual operation is required of work which contacts some specific "points" correctly with automata, such as a robot, and there is a problem of it being difficult to perform exact coordinate system setting for a short time, and being easy to come by factors, such as a skillful degree of an operator, out of gross errors.

[0007]Since the tatting by automata, such as a robot, is indispensable, the restrictions of the ability not to make an automaton recognizing the coordinate system expressive medium (for example, specific reference position distant near the automaton in working clearance) which exists in the position outside the working range of an automaton are not escaped.

[0008]Then, the purpose of the invention in this application is to conquer the problem of the coordinate-system-setting method of such a conventional contact method. Namely, the invention in this application can set a coordinate system as automata, such as a robot, with the non-contact method using a visual sensor in the accuracy stable by easy operation in which the level of skill is not required of an operator. Even if a coordinate system expressive medium exists outside the working range of an automaton, it is in providing the coordinate-system-setting method which an automaton is made to recognize a coordinate system and can set a coordinate system as it.

[0009]

[Means for Solving the Problem]as a means by which this invention solves an aforementioned problem -- "(a) -- several positions which make an automaton with which at least one standard coordinates are set up support a camera means of a visual sensor, and are different, [make take them and] A stage of observing a coordinate system expressive medium which expresses a coordinate system wishing setting out visually in each of a position of these plurality by said camera means, and gaining sensor data about said coordinate system wishing setting out, (b) Based on data showing said several mutually different positions of an automaton, and said gained sensor data, A coordinate-system-setting method using a visual sensor including a stage of gaining data showing a position and a posture of said coordinate system wishing setting out to said at least one standard coordinates" is proposed.

[0010]

[Function]The invention in this application is replaced with the contact method by automata, such as the conventional robot, and the method which observes the coordinate system expressive medium which expressed the coordinate system visually with the visual sensor which made automata, such as a robot, support a camera means is used for it. The robot which is a typical automaton of the mold provided with the movable part which performs route movement hereafter according to the operation program containing position data is taken for an example, and the setting-out principle of the coordinate system in the invention in this application is explained using drawing 1.

[0011]In drawing 1, the numerals 1 express a robot and the camera 2 (for example, video

camera using a CCD element) which forms some visual sensors is supported by the arm tip. And the numerals 3 express the coordinate system expressive medium which expresses visually the position and posture of the coordinate system (it is called the following "setting-out coordinate system".) which wishes to set up. Here, it is sigmac about a setting-out coordinate system. ; It is referred to as Oc -Xc Yc Zc, The jig in which the home position Oc, Xc shaft orientations, Yc shaft orientations, and a Xc -Yc plane direction (Z shaft orientations turn into the direction of the outer product of the normal vector, i.e., the unit vector of Xc shaft orientations, and the unit vector of Yc shaft orientations) were expressed by the matrix form point group 4 is shown.

[0012]The coordinate system expressive medium 3 does not necessarily need to be the jig in which the point group was described, and if the position and posture of a setting-out coordinate system are expressed visually, it can use arbitrary means. For example, the characterizing portions (ridgeline etc.) of the mark described in the floor line and the work put on the prescribed position can be used.

[0013]Unlike conventional technology, the setting-out position (position of a coordinate system expressive medium) of a coordinate system does not have the restrictions which exist in the working range of the robot 1 that it will not become if it kicks, If the camera 2 is a range which can put a coordinate system expressive medium into a view normally by making it take the suitable position for the robot 1, a coordinate system can be set as arbitrary positions.

[0014]While base coordinate system sigmab used as the standard coordinates fixed in working clearance is set to the robot 1, centering on the face shield (or tool point), coordinate system sigmaa (a face shield coordinate system or a tool coordinate system) showing a robot position is set up. sigmas expresses the sensor coordinate system set as the visual sensor containing the camera 2.

[0015]Here, the robot 1 is made to take the two positions A1 and A2, and the position relationship of each coordinate system at the time of observing the coordinate system expressive medium 3 with the camera 2 in each robot position is considered. The procession (four-line four-row homogeneous transformation procession) expressing the relation between each coordinate system is carried out as follows.

[0016][C]; setting out of coordinate system sigmac is performed by the data of this procession in procession showing the position and posture of setting-out coordinate system sigmac seen from base coordinate system sigmab. That is, it is a strange procession which should be searched for for coordinate system setting.

[A1]; it is a procession showing the position and posture of the robot position A1 seen from base coordinate system sigmab, and is the known procession which the robot recognizes.

[0017][A2]; it is a procession showing the position and posture of the robot position A2 seen from base coordinate system sigmab, and is the known procession which the robot recognizes.

[0018][S]; it will become a known procession if the calibration of the visual sensor containing the camera 2 is performed in procession showing the position and posture of sensor coordinate system sigmas seen from the robot position.

[0019][D1]; it is in the state which has a robot in the position A1, and is a procession showing the position and the posture in which setting-out coordinate system sigmac was seen from sensor coordinate system sigmas. It is calculated by correcting the

observational data based on the camera 2 of the coordinate system expressive medium (here point group 4) in the robot position A1 using calibration data.
[0020][D2]; it is in the state which has a robot in the position A2, and is a procession showing the position and the posture in which setting-out coordinate system sigmac was seen from sensor coordinate system sigmas. It is calculated by correcting the observational data based on the camera 2 of the coordinate system expressive medium (here point group 4) in the robot position A2 using calibration data.
[0021]If each procession is defined as above, both the following formulas will be materialized.
[C] -- =[A1] -[S] - [D1] ... [C] =[A2] -[S] - [D2] $[A1]^{-1}$, [S], and $[D1]^{-1}$=$[A2]^{-1}$, [S], and $[D2]^{-1}$ from (2), (1), and (2) types ... ... (3) is obtained. (1)
[0022]Here, the robot 1 is the quantity recognized as present position data in the position A1 and A2, and [A1] and [A2] are known. [D1] and [D2] are [in / are a procession showing the position and posture of setting-out coordinate system sigmac seen from sensor coordinate system sigmas in each robot position A1 and A2, and / each position] the characterizing portions (although it is the point group 4 which consists of two or more points here) on the jig 3 with the camera 2. for example, a line expresses -- it may have -- it is the quantity which observes and is calculated based on the data (interval of a point, etc.) about the observational data and point group 4.
[0023]Therefore, if it asks for the data which is equivalent to [D1] and [D2] in the two positions A1, A2, or a different position beyond it, a procession [C] can be searched for from (3) types.
[0024]Generally the calculation which asks for the data which is equivalent to [D1] and [D2] from the data about the observational data and the point group 4 which were acquired with the camera 2 is called the calibration of the camera.
Various methods are known.
Which method may be used in the invention in this application. From the point group 4 which consists of many points to for example, two or more points (at least three pieces theoretically) However, when taking the aberration of a camera lens into consideration, it is pointed out with Mr. Tsai's model that at least seven stations are required. There is a method of gaining calibration data from the related pixel value data. As an example of the literature in which the details of the calibration of the camera used for a visual sensor were described, "Roger Y. Tsai, "An efficient and accurate camera calibration technique for 3d machine vision ", Proc. Computer Vision and. There are Pattern Recognition'86 and pp.364-374-1986."
[0025]
[Example]Drawing 2 is the block diagram which illustrated the important section of the camera 2 which constitutes the visual sensor used when carrying out the invention in this application, and the image processing device 10 connected to this. Among a figure, the image processing device 10 has the central arithmetic unit (henceforth CPU) 11, and via the bus 21 to CPU1, The camera interface 12, the image processing processor 13, The console interface 4, the communication interface 15, The data memory 20 which comprised the TV monitor interface 16, the frame memory 17, the memory 18 for control soft that comprised a ROM, the program memory 19 which comprised RAM, and non-volatile RAM is connected. The camera 2 which put the jig 3 as a coordinate system expressive medium into the view in the mode of drawing 1 is connected to the camera

interface 12.
[0026]It is connected by several sets if needed and this camera 2 detects the position of the work object (for example, important point working piece) performed after setting out of coordinate system sigmac, and it is constituted so that the data for position amendment may be transmitted to the robot control device (graphic display abbreviation) connected to the communication interface 15.
[0027]Although the camera 2 showed only one set, it may work by connecting several cameras to the communication interface 15 at once. In that case, common sensor coordinate system sigmas is set up, for example for every camera.
[0028]The picture caught with the camera 2 is changed into the shade image changed into the gray scale, and is stored in the frame memory 17. The image processing processor 13 processes the image data stored in the frame memory 17, the image of the focus of the jig J is recognized, and it has the function to detect the position (it is a central pixel value when a corresponding-picture-elements value and an image have a spread).
[0029]The console 23 is connected to the console interface 14, and the outside console 23 has a ten key for operating various kinds of instruction keys, input of an application program, edit, registration, execution, etc. outside a liquid crystal display, etc. And the menu for various data setting out, the list of programs, etc. can be displayed now on a liquid crystal display.
[0030]The control program for CPU11 to control a vision sensor system is stored in the memory 18 for control soft.
The program which a user produces is stored in the program memory 19.

[0031]The automaton (here robot) using the position information on the work etc. which the visual sensor detected, etc. are connected to the communication interface 15. The TV monitor 24 which can project selectively the picture stored in the picture or the frame memory 17 under photography with the camera C is connected to TV monitor interface 16.
[0032]Although there is no place which the above composition and function change fundamentally with the composition of the conventional vision sensor system, in operation of the invention in this application, It differs from a system conventionally in that it is said that a program and required data (data of the interval of the point group on the jig 3, the number, etc.) required in order to perform processing described into the flow chart of drawing 3 are stored in the memory 18 for control soft, or the data memory 20. Hereafter, the operating procedure for coordinate system sigmac setting out and processing are explained as what preparatory works, such as setting out of the camera 2 and an entry of data of the jig 3, have completed.
[0033]First, an operator operates a robot control device (graphic display abbreviation), and moves the robot 1 to the 1st suitable position A1 to which the jig 3 is easily settled in the view of the camera 2 (Step S1). And the data of a procession [A1] which expresses the position A1 from a robot control device is made to transmit, and it memorizes to the data memory 20 (Step S2).
[0034]Subsequently, observation (photography) with the camera 2 is performed in the robot position A1, and the image of the point group 4 is captured into the frame memory 17 (Step S3). If photography is completed, it will ask for the data of [D1] from the pixel value of each point of the point group 4, and jig data (data of the interval of a point

group, a number, etc.) (step S4).
[0035]Similarly, an operator moves the robot 1 to the 2nd suitable position A2 to which the jig 3 is easily settled in the view of the camera 2 (Step S5), makes the data of a procession [A2] which expresses the position A2 from a robot control device transmit, and is memorized to the data memory 20 (Step S6).
[0036]Subsequently, observation (photography) with the camera 2 is performed in the robot position A2, and the image of the point group 4 is captured into the frame memory 17 (Step S7). If photography is completed, it will ask for the data of [D2] from the pixel value of each point of the point group 4, and jig data (data of the interval of a point group, a number, etc.) (Step S8).
[0037]By continuing step S9D, according to the above-mentioned formula (3), a procession [C] is calculated using these data, and a result is transmitted to a robot control device (Step S10). A robot control device stores the transmitted data in a predetermined memory area as coordinate-system-setting data, and ends processing.
[0038]The processing of those other than Step [under above-mentioned procedure] S3 and step S7 may perform all by the robot control device side in part.
[0039]
[Effect of the Invention]According to the invention in this application, a coordinate system can be set as automata, such as a robot, with the non-contact method using a visual sensor in the accuracy stable by easy operation in which the level of skill is not required of an operator. It became possible to make an automaton recognize a coordinate system and to set a coordinate system as it by the invention in this application, even if a coordinate system expressive medium exists outside the working range of automata, such as a robot.

TECHNICAL FIELD

[Industrial Application]Concerning the method of setting a coordinate system as automata, such as a robot, in more detail, a visual sensor is used in this invention. Therefore, it is related with the method of setting a coordinate system as coordinate system expressive media, such as a jig for coordinate system setting, by non-contact at automata, such as a robot.

PRIOR ART

[Description of the Prior Art]In the automaton of the mold provided with the movable part which performs route movement according to the operation program which contains the data (only henceforth "position data") showing a position and a posture like a robot and a machine tool, two or more coordinate systems are set up and the conformity coordinate system at the time of operation is chosen according to work contents.
[0003]If the standard coordinates (henceforth a base coordinate system) fixed on the base of an automaton are ending with setting out, setting out of other coordinate systems will be attained by defining the transformation-matrix data showing the position and posture over the base coordinate system set [this] up.
[0004]In setting up a new coordinate system with such a method conventionally, Carry out fixed installation of the jig which expressed the coordinate system by the point group

etc. to the position wishing setting out, and two or more prescribed spots of this jig are tagged up one by one in the portion representing the position of automata, such as a robot, Asking for transformation-matrix data is performed from the data of the touch position on a jig, and the position data of the automaton at the time of touch-up.
[0005]The point of specifically expressing the starting point as the 1st point, for example (0, 0, 0), The point of expressing X shaft orientation as the 2nd point (x0, 0, 0); Point (0, y0, 0);y0 !=0 on x0 !=0 and the Y-axis which expresses the direction of an XY plane as the 3rd point is chosen, The pin which an automaton tends to touch is set to these three points, manual operation (jogging) of the automaton is carried out, and these pins are touched directly [order]. And the data (transformation-matrix data) which expresses relative position and posture over the base coordinate system of the coordinate system expressed with the jig from the position data of the automaton at the time of each tatting and the data of a touch position is called for.
[0006]

EFFECT OF THE INVENTION

[Effect of the Invention]According to the invention in this application, a coordinate system can be set as automata, such as a robot, with the non-contact method using a visual sensor in the accuracy stable by easy operation in which the level of skill is not required of an operator. It became possible to make an automaton recognize a coordinate system and to set a coordinate system as it by the invention in this application, even if a coordinate system expressive medium exists outside the working range of automata, such as a robot.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, very strict and delicate manual operation is required of work which contacts some specific "points" correctly with automata, such as a robot, and there is a problem of it being difficult to perform exact coordinate system setting for a short time, and being easy to come by factors, such as a skillful degree of an operator, out of gross errors.
[0007]Since the tatting by automata, such as a robot, is indispensable, the restrictions of the ability not to make an automaton recognizing the coordinate system expressive medium (for example, specific reference position distant near the automaton in working clearance) which exists in the position outside the working range of an automaton are not escaped.
[0008]Then, the purpose of the invention in this application is to conquer the problem of the coordinate-system-setting method of such a conventional contact method. Namely, the invention in this application can set a coordinate system as automata, such as a robot, with the non-contact method using a visual sensor in the accuracy stable by easy operation in which the level of skill is not required of an operator. Even if a coordinate system expressive medium exists outside the working range of an automaton, it is in providing the coordinate-system-setting method which an automaton is made to recognize a coordinate system and can set a coordinate system as it.

MEANS

[Means for Solving the Problem]as a means by which this invention solves an aforementioned problem -- "(a) -- several positions which make an automaton with which at least one standard coordinates are set up support a camera means of a visual sensor, and are different, [make take them and] A stage of observing a coordinate system expressive medium which expresses a coordinate system wishing setting out visually in each of a position of these plurality by said camera means, and gaining sensor data about said coordinate system wishing setting out, (b) Based on data showing said several mutually different positions of an automaton, and said gained sensor data, A coordinate-system-setting method using a visual sensor including a stage of gaining data showing a position and a posture of said coordinate system wishing setting out to said at least one standard coordinates" is proposed.

OPERATION

[Function]The invention in this application is replaced with the contact method by automata, such as the conventional robot, and the method which observes the coordinate system expressive medium which expressed the coordinate system visually with the visual sensor which made automata, such as a robot, support a camera means is used for it. The robot which is a typical automaton of the mold provided with the movable part which performs route movement hereafter according to the operation program containing position data is taken for an example, and the setting-out principle of the coordinate system in the invention in this application is explained using drawing 1.

[0011]In drawing 1, the numerals 1 express a robot and the camera 2 (for example, video camera using a CCD element) which forms some visual sensors is supported by the arm tip. And the numerals 3 express the coordinate system expressive medium which expresses visually the position and posture of the coordinate system (it is called the following "setting-out coordinate system".) which wishes to set up. Here, it is sigmac about a setting-out coordinate system. ; It is referred to as Oc -Xc Yc Zc, The jig in which the home position Oc, Xc shaft orientations, Yc shaft orientations, and a Xc -Yc plane direction (Z shaft orientations turn into the direction of the outer product of the normal vector, i.e., the unit vector of Xc shaft orientations, and the unit vector of Yc shaft orientations) were expressed by the matrix form point group 4 is shown.

[0012]The coordinate system expressive medium 3 does not necessarily need to be the jig in which the point group was described, and if the position and posture of a setting-out coordinate system are expressed visually, it can use arbitrary means. For example, the characterizing portions (ridgeline etc.) of the mark described in the floor line and the work put on the prescribed position can be used.

[0013]Unlike conventional technology, the setting-out position (position of a coordinate system expressive medium) of a coordinate system does not have the restrictions which exist in the working range of the robot 1 that it will not become if it kicks, If the camera 2 is a range which can put a coordinate system expressive medium into a view normally by making it take the suitable position for the robot 1, a coordinate system can be set as arbitrary positions.

[0014]While base coordinate system sigmab used as the standard coordinates fixed in working clearance is set to the robot 1, centering on the face shield (or tool point), coordinate system sigmaa (a face shield coordinate system or a tool coordinate system) showing a robot position is set up. sigmas expresses the sensor coordinate system set as the visual sensor containing the camera 2.
[0015]Here, the robot 1 is made to take the two positions A1 and A2, and the position relationship of each coordinate system at the time of observing the coordinate system expressive medium 3 with the camera 2 in each robot position is considered. The procession (four-line four-row homogeneous transformation procession) expressing the relation between each coordinate system is carried out as follows.
[0016][C]; setting out of coordinate system sigmac is performed by the data of this procession in procession showing the position and posture of setting-out coordinate system sigmac seen from base coordinate system sigmab. That is, it is a strange procession which should be searched for for coordinate system setting.
[A1]; it is a procession showing the position and posture of the robot position A1 seen from base coordinate system sigmab, and is the known procession which the robot recognizes.
[0017][A2]; it is a procession showing the position and posture of the robot position A2 seen from base coordinate system sigmab, and is the known procession which the robot recognizes.
[0018][S]; it will become a known procession if the calibration of the visual sensor containing the camera 2 is performed in procession showing the position and posture of sensor coordinate system sigmas seen from the robot position.
[0019][D1]; it is in the state which has a robot in the position A1, and is a procession showing the position and the posture in which setting-out coordinate system sigmac was seen from sensor coordinate system sigmas. It is calculated by correcting the observational data based on the camera 2 of the coordinate system expressive medium (here point group 4) in the robot position A1 using calibration data.
[0020][D2]; it is in the state which has a robot in the position A2, and is a procession showing the position and the posture in which setting-out coordinate system sigmac was seen from sensor coordinate system sigmas. It is calculated by correcting the observational data based on the camera 2 of the coordinate system expressive medium (here point group 4) in the robot position A2 using calibration data.
[0021]If each procession is defined as above, both the following formulas will be materialized.
[C] -- =[A1] -[S] - [D1] ... [C] =[A2] -[S] - [D2] [A1] $^{-1}$, [S], and [D1] $^{-1}$=[A2] $^{-1}$, [S], and [D2] $^{-1}$ from (2), (1), and (2) types ... ... (3) is obtained. (1)
[0022]Here, the robot 1 is the quantity recognized as present position data in the position A1 and A2, and [A1] and [A2] are known. [D1] and [D2] are [in / are a procession showing the position and posture of setting-out coordinate system sigmac seen from sensor coordinate system sigmas in each robot position A1 and A2, and / each position] the characterizing portions (although it is the point group 4 which consists of two or more points here) on the jig 3 with the camera 2. for example, a line expresses -- it may have -- it is the quantity which observes and is calculated based on the data (interval of a point, etc.) about the observational data and point group 4.
[0023]Therefore, if it asks for the data which is equivalent to [D1] and [D2] in the two

positions A1, A2, or a different position beyond it, a procession [C] can be searched for from (3) types.
[0024]Generally the calculation which asks for the data which is equivalent to [D1] and [D2] from the data about the observational data and the point group 4 which were acquired with the camera 2 is called the calibration of the camera.
Various methods are known.
Which method may be used in the invention in this application. From the point group 4 which consists of many points to for example, two or more points (at least three pieces theoretically) However, when taking the aberration of a camera lens into consideration, it is pointed out with Mr. Tsai's model that at least seven stations are required. There is a method of gaining calibration data from the related pixel value data. As an example of the literature in which the details of the calibration of the camera used for a visual sensor were described, "Roger Y. Tsai, "An efficient and accurate camera calibration technique for 3d machine vision ", Proc. Computer Vision and. There are Pattern Recognition'86 and pp.364-374-1986."

EXAMPLE

[Example]Drawing 2 is the block diagram which illustrated the important section of the camera 2 which constitutes the visual sensor used when carrying out the invention in this application, and the image processing device 10 connected to this. Among a figure, the image processing device 10 has the central arithmetic unit (henceforth CPU) 11, and via the bus 21 to CPU1, The camera interface 12, the image processing processor 13, The console interface 4, the communication interface 15, The data memory 20 which comprised the TV monitor interface 16, the frame memory 17, the memory 18 for control soft that comprised a ROM, the program memory 19 which comprised RAM, and non-volatile RAM is connected. The camera 2 which put the jig 3 as a coordinate system expressive medium into the view in the mode of drawing 1 is connected to the camera interface 12.
[0026]It is connected by several sets if needed and this camera 2 detects the position of the work object (for example, important point working piece) performed after setting out of coordinate system sigmac, and it is constituted so that the data for position amendment may be transmitted to the robot control device (graphic display abbreviation) connected to the communication interface 15.
[0027]Although the camera 2 showed only one set, it may work by connecting several cameras to the communication interface 15 at once. In that case, common sensor coordinate system sigmas is set up, for example for every camera.
[0028]The picture caught with the camera 2 is changed into the shade image changed into the gray scale, and is stored in the frame memory 17. The image processing processor 13 processes the image data stored in the frame memory 17, the image of the focus of the jig J is recognized, and it has the function to detect the position (it is a central pixel value when a corresponding-picture-elements value and an image have a spread).
[0029]The console 23 is connected to the console interface 14, and the outside console 23 has a ten key for operating various kinds of instruction keys, input of an application program, edit, registration, execution, etc. outside a liquid crystal display, etc. And the menu for various data setting out, the list of programs, etc. can be displayed now on a

liquid crystal display.
[0030]The control program for CPU11 to control a vision sensor system is stored in the memory 18 for control soft.
The program which a user produces is stored in the program memory 19.

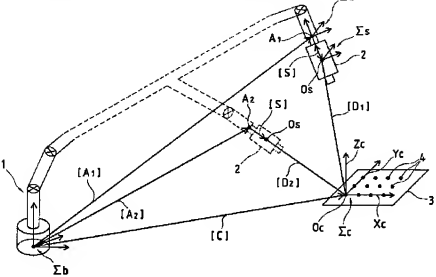
[0031]The automaton (here robot) using the position information on the work etc. which the visual sensor detected, etc. are connected to the communication interface 15. The TV monitor 24 which can project selectively the picture stored in the picture or the frame memory 17 under photography with the camera C is connected to TV monitor interface 16.
[0032]Although there is no place which the above composition and function change fundamentally with the composition of the conventional vision sensor system, in operation of the invention in this application, It differs from a system conventionally in that it is said that a program and required data (data of the interval of the point group on the jig 3, the number, etc.) required in order to perform processing described into the flow chart of drawing 3 are stored in the memory 18 for control soft, or the data memory 20. Hereafter, the operating procedure for coordinate system sigmac setting out and processing are explained as what preparatory works, such as setting out of the camera 2 and an entry of data of the jig 3, have completed.
[0033]First, an operator operates a robot control device (graphic display abbreviation), and moves the robot 1 to the 1st suitable position A1 to which the jig 3 is easily settled in the view of the camera 2 (Step S1). And the data of a procession [A1] which expresses the position A1 from a robot control device is made to transmit, and it memorizes to the data memory 20 (Step S2).
[0034]Subsequently, observation (photography) with the camera 2 is performed in the robot position A1, and the image of the point group 4 is captured into the frame memory 17 (Step S3). If photography is completed, it will ask for the data of [D1] from the pixel value of each point of the point group 4, and jig data (data of the interval of a point group, a number, etc.) (step S4).
[0035]Similarly, an operator moves the robot 1 to the 2nd suitable position A2 to which the jig 3 is easily settled in the view of the camera 2 (Step S5), makes the data of a procession [A2] which expresses the position A2 from a robot control device transmit, and is memorized to the data memory 20 (Step S6).
[0036]Subsequently, observation (photography) with the camera 2 is performed in the robot position A2, and the image of the point group 4 is captured into the frame memory 17 (Step S7). If photography is completed, it will ask for the data of [D2] from the pixel value of each point of the point group 4, and jig data (data of the interval of a point group, a number, etc.) (Step S8).
[0037]By continuing step S9D, according to the above-mentioned formula (3), a procession [C] is calculated using these data, and a result is transmitted to a robot control device (Step S10). A robot control device stores the transmitted data in a predetermined memory area as coordinate-system-setting data, and ends processing.
[0038]The processing of those other than Step [under above-mentioned procedure] S3 and step S7 may perform all by the robot control device side in part.

DESCRIPTION OF DRAWINGS

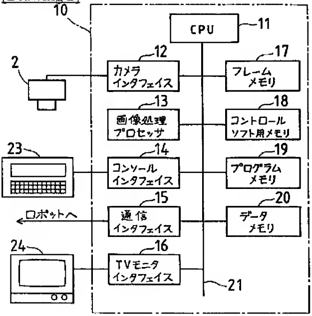
[Brief Description of the Drawings]
[Drawing 1]It is a figure for taking a robot for an example and explaining the setting-out principle of the coordinate system in the invention in this application.
[Drawing 2]It is the block diagram which illustrated the important section of the camera which constitutes the visual sensor used when carrying out the invention in this application, and the image processing device connected to this.
[Drawing 3]It is a flow chart explaining the operation for setting up a coordinate system according to the invention in this application, and procedure.
[Description of Notations]
1 Robot
2 Camera
3 Coordinate system expressive medium (jig)
4 Point group
10 Image processing device
11 Central arithmetic unit (CPU)
12 Camera interface
13 Image processing processor
14 Console interface
15 Communication interface
16 TV monitor interface
17 Frame memory
18 The memory for control soft
19 Program memory
20 Data memory
21 Bus
23 Console
24 TV monitor

DRAWINGS

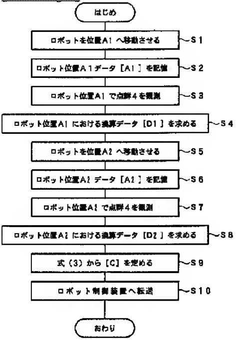
[Drawing 1]



[Drawing 2]



[Drawing 3]



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